Safety Evaluation of Red-Light Cameras

Two Related Papers

A Multi-Jurisdictional Safety Evaluation of Red-Light Cameras

Economic Analysis of Safety Effects of Red-Light Camera Programs and Identification of Factors Associated with Greatest Benefits

Bhagwant Persaud (Ryerson University)
Forrest Council (BMI-SG)
Michael Griffith (FHWA Safety R&D)
And Others

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Motivation for Study

- Lack of definitive evidence about the effect of red-light camera systems on crashes due to methodology problems in past studies.
- Need to combine opposing effects of RLCs on *angle* and ***rear-end*** crashes (which are of differing severities)
- Need for multi-jurisdictional study using consistent methodology

Steps of the Study

- Identified sample metropolitan areas where RLCs had been deployed.
- Collected data on traffic volumes, crash frequencies, etc. for
  - intersections with RLCs,
  - additional intersections.
- Used the state-of-the-art research methods to estimate changes in right angle and rear end crashes following RLC installation.
- Developed and applied unit economic crash costs to "translate" changes in crashes to a net change in total crash costs.
- Identified factors contributing to RLC effectiveness to develop guidelines for selecting intersections for RLC deployment.

Methodological Needs

To overcome the limitations of previous evaluations by using sufficient treatment, reference and comparison sites to:

- properly account for regression-to-the-mean
- properly account for spillover effects
- properly account for changes from the before to after period in
  - reporting practices
  - traffic volumes
  - other factors
- estimate effects with confidence

Empirical Bayes Methodology

- Compares crash counts in the "after" period to an estimate of what would have occurred without RLC (*B*).

- *B* is a weighted average of the crash counts in the "before period" at a given intersection and the number of crashes expected to occur at similar sites (*P*).

- *P* is estimated from a safety performance function that links crashes to traffic volumes and site characteristics.

Study Jurisdictions

Jurisdiction	Treated Sites	Signalized Reference and Spillover analysis sites	Unsignalized Comparison Sites	
Baltimore	19	86	46	
Charlotte	31	74	42	
El Cajon	6	53	38	
Howard County	18	34	38	
Montgomery County	21	55	40	
San Diego	19	54	44	
San Francisco	18	52	48	
Total	132	408	296	

RLC Crashes Defined

- Crashes in the intersection itself where one vehicle may be "running the light"
  - Side impacts from adjacent approaches (right angle)
  - Left turning with on-coming vehicle
- Intersection-related rear-end crashes

Combined Results For The Seven Jurisdictions

	Right-angle		Rear-end	
	Total	(Definite Injury)	Total	(Definite) Injury
EB estimate of crashes expected in the after period without RLC	1542	351	2521	131
Count of crashes observed in the after period	1163	296	2896	163
Estimate of the change in crash frequency	-379	- 55	375	32
Estimate of percent change	-24.6	- 15.7	14.9	24.0

Results From Individual Jurisdictions (All Severities)

Jurisdiction number (in random order)	Right-angle	Rear-end
	Change	Change
1	- 40.0%	21.3%
2	0.8%	8.5%
3	- 14.3%	15.1%
4	- 24.7%	19.7%
5	- 34.3%	38.1%
6	- 26.1%	12.7%
7	- 24.4%	7.0%

Before-after Results For Total Crashes At *Spillover* Intersections

- Modest decrease in right angle crashes
- Negligible increase in rear-end crashes
- Further study needed

Fundamental Issue

- Does the increase in rear-end crashes negate the benefits for right-angle crashes?
  - 25% decrease for total right-angle
  - 16% decrease for injury right-angle
  - 15% increase for total rear-end
  - 24% increase for injury rear-end

- Since angles and rear-ends are different severities, must combine using economic costs

Economic Analysis

- Required estimates of ***comprehensive cost per crash*** for angle, rear-end and other crash types by severity level

- New (2001) crash cost estimates developed by:
  - Linking economic costs per injury for different components with NASS-CDS and GES data which included both AIS injury severity scale and KABCO scales for different crash types.
  - Converting *cost per victim* into *cost per crash* for 21 different crash types and KABCO severities (e.g., cost of A-level angle crash at signalized intersection with speed limit of □45 mph).

- Cost per crash was then used in EB methodology to estimate overall economic effect of RLC.

EB Method for Economic Costs

- Due to sample sizes, involved two severity categories for each crash types -- *injury* vs. *non-injury*
- “Expected *injury* and *non-injury* crashes without treatment” generated with EB methodology for three crash types -- angle, rear-end, other
- “Expected without treatment costs” = expected frequency × cost per crash
- “Observed with-treatment costs” = observed frequencies × cost per crash
- “Expected without treatment costs” compared to “observed with-treatment costs”
- Results aggregated across all crash severities, crash types, and sites.

Comprehensive Crash Cost Estimates For Urban Signalized Intersections

Crash Severity Level	Angle Crash Cost	Rear-end Crash Cost
K	$4,090,042	$3,781,989
A	$120,810	$84,820
B	$103,468	$27,043
C	$34,690	$49,746
O	$8,673	$11,463
K+A+B+C "injury crash"	$64,468	$53,659

Economic Effects Including And Excluding PDOs

(Using a combined unit cost for K+A+B+C)

	All severities combined	PDOs excluded
Overall crash cost decrease	$14,372,471	$18,505,419
Cost decrease per site year	$38,845	$50,015

Factors Associated With The Greatest Economic Benefits

- ✓ Higher ratios of right-angle to rear-end
- ✓ Higher proportions of entering AADT on the major road
- ✓ One or more left turn protected phases
- ✓ Higher entering AADT
- ✓ Warning signs at both RLC intersections and city limits
- ✓ High publicity level

FHWA Report

- Will be released very soon
- Executive Summary is at

http://www.tfhrc.gov/safety/pubs/05049/index.htm

Questions?